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STERILIZATION BY LIQUID CHLORINE AND HYPOCHLORITE OF LIME

By M. S. Dutton

In the following comparison of the use of liquid chlorine and hypochlorite of lime, the data apply in particular to one filtration plant, a description of which follows, and in general to other installations where this means of sterilization are in use. The plant was put in operation the latter part of January, 1915. The water supply is taken from a small stream and is at all times subject to contamination by sewage and waste water from coal mines. The supply is pumped from the stream by two triplex plunger pumps at a low-lift pump house, three-quarters of a mile to the filtration plant. It flows through a weir box, mixing chamber, two coagulating basins, three filter units, and thence to a clear well under the filter building. From this clear well the water flows to another larger clear well from which the service pumps draw their supply. A very satisfactory place for the application of either liquid chlorine or hypochlorite of lime has been the 8-inch pipe connecting the two clear wells. This place for the application has eliminated any loss of chlorine due to direct contact with the air and splashing water. The plant has a capacity of 900,000 gallons per day and was constructed with tanks for appying hypochlorite. Although the use of liquid chlorine was considered, the cost of an apparatus for the application of the chlorine seemed excessive in view of the fact, too, that the apparatus had not been perfected to its present state. In February, 1916, it was decided to purchase a chlorinator and since that time all former troubles connected with the application of hypochlorite have been eliminated.

The installation consists of a chlorinator of the type which supplies a solution of chlorine and water to the supply. Liquid chlorine is received in drums containing 105 pounds and as it feeds to the chlorinator, expanding to a gas, it is mixed with water and fed through a hard rubber hose to the point of application. The manufacturers of this apparatus claim many advantages over the use of hypochlorite, the most important of which are:

Cost analysis of liquid chlorine and hypochlorite

DATE 1916	PUMPAGE	HYPO USED	HYPO USED PER MILLION GALLONS	COST OF HYPO PER MILLION GALLONS	DATE 1916	PUMPAGE	LIQUID CHLORINE USED	LIQUID CHLORINE USED PER MILLION GALLONS	COST OF LIQUID CHLORINE PER MILLION GALLONS
	gallons	*pounds*				*gallons*	*pounds*		
January					June				
1	276,500	5.2	18.8	$1.32	1	282,000	0.39	1.38	$0.28
2	237,500	3.8	16.0	1.12	2	286,000	0.40	1.40	0.28
3	244,000	3.5	14.3	1.00	3	294,000	0.42	1.43	0.29
4	277,000	4.6	16.6	1.16	4	263,000	0.37	1.41	0.28
5	208,000	3.3	15.9	1.11	5	337,500	0.48	1.42	0.28
6	216,500	3.6	16.6	1.16	6	289,500	0.41	1.42	0.28
7	239,500	3.7	15.5	1.08	7	331,000	0.47	1.42	0.28
8	252,600	5.8	23.0	1.61	8	239,000	0.34	1.42	0.28
9	273,000	5.5	20.2	1.41	9	308,000	0.43	1.40	0.28
10	369,000	5.0	13.6	0.96	10	212,500	0.30	1.41	0.28
11	340,000	6.1	17.9	1.25	11	202,000	0.28	1.39	0.28
12	262,500	3.8	14.5	1.01	12	221,500	0.31	1.40	0.28
13	354,000	4.6	13.0	0.91	13	192,000	0.27	1.41	0.28
14	600,000	11.1	18.5	1.29	14	308,000	0.43	1.40	0.28
15	475,000	8.7	18.3	1.28	15	248,000	0.35	1.41	0.28
16	284,000	10.4	36.6	2.56	16	233,000	0.33	1.42	0.28
17	444,000	6.7	15.1	1.06	17	216,500	0.30	1.39	0.28
18	433,000	5.9	13.6	0.96	18	300,000	0.42	1.40	0.28
19	416,000	5.0	12.0	0.84	19	402,000	0.57	1.42	0.28
20	433,000	4.3	9.9	0.69	20	244,000	0.34	1.39	0.28
21	481,000	4.6	9.6	0.67	21	175,000	0.25	1.43	0.29
22	378,000	5.4	14.3	1.00	22	336,000	0.47	1.40	0.28
23	288,000	4.8	16.7	1.17	23	202,000	0.28	1.39	0.28
24	283,000	4.5	15.9	1.11	24	214,000	0.30	1.40	0.28
25	288,000	4.5	15.6	1.09	25	380,000	0.54	1.42	0.28
26	359,000	4.3	12.0	0.84	26	352,000	0.50	1.42	0.28
27	221,000	2.9	13.1	0.92	27	404,000	0.57	1.41	0.28
28	423,000	2.7	6.4	0.45	28	352,000	0.49	1.39	0.28
29	316,200	3.3	10.4	0.73	29	361,000	0.53	1.47	0.29
30	222,400	2.8	12.6	0.88	30	316,000	0.46	1.47	0.29
31	336,000	2.8	8.3	0.58					
Total	10,230,700	153.2				8,501,500	12.0		
Average	330,000	4.9	15.3	1.07		283,380	0.40	1.41	0.28

Note: Cost of hypochlorite, 7 cents per pound; cost of liquid chlorine, 20 cents per pound.

1. A more accurate means of control.
2. An elimination of dirt and the odor of chlorine.
3. An appreciable decrease in labor.
4. A means of storing the chemical so as to eliminate any decrease in strength.
5. An elimination of chlorine taste in the treated water which is so often found where hypochlorite is used.
6. A decrease in the cost of chemical required.

After having this apparatus in service a little over a year, to date, the first five claims for this method of sterilization have been realized and the accompanying figures substantiate the claim that a material decrease has been made in the cost of chemicals.

Summarizing briefly the tabulated cost analysis, the cost of hypochlorite being considered as 7 cents per pound and the cost of liquid chlorine as 20 cents per pound, the average cost of sterilization by means of hypochlorite was $1.07 per million gallons of water treated and $0.28 per million gallons when using liquid chlorine. The saving, then, in chemicals alone amounted to $0.79 per million gallons of water treated.

In summarizing the results of sterilization, the average reduction in bacteria count of daily plates made on nutrient agar incubated at 37°C. for 24 hours was as follows: In January, when hypochlorite was used, the average raw water count was 6300 and the filtered water count was 15. In June, when liquid chlorine was used, the average raw water count was 7980 and the filtered water count was 11. In B. coli tests, the raw water shows 100 per cent + for both months, while the filtered water shows 1.60 per cent + in January and 0.0 per cent + in June. These results were obtained by means of 1 cc. samples in all cases. Also note that while hypochlorite was used 0.46 p.p.m. of chlorine was applied and while using liquid chlorine 0.22 p.p.m. of chlorine was applied.

As previously stated, and as brought out in subsequent operation reports, sterilization by liquid chlorine has eliminated numerous former troubles and has at all times affected a saving in the cost of chemicals required.